

# 1957 Buyers' Guide Edition

MID-DECEMBER 1956 \$3.00

# AVIATION WEEK

A WHEELING PRESS PUBLICATION



**A**

**AIRCRAFT**

**B**

**MISSILES**

**C**

**AVIONICS**

**D**

**SUPPORTING  
EQUIPMENT**

**E**

**NUCLEAR  
SYSTEMS**

**F**

**AIRLINE &  
AIRPORT  
EQUIPMENT**



# How to use the 1957 Buyers' Guide

This second annual edition of the Aviation Week Buyers' Guide is geared to keep pace with the continuing changes forced upon the aircraft industry by the introduction of new and advanced weapon systems.

## SECTIONALIZED FORMAT . . .

The Guide divides its manufactured products listing into six separate sections of related interest. This is done for maximum convenience in finding any particular item or service.

## IF YOU ARE BUYING . . .

Refer to the alphabetical product index which follows to find the page number of each specific product with its manufacturers. All products in this Guide are indexed by section and page number. For example: Alternators . . . C-4 . . . would be found in Section C, page 6.

## IF YOU ARE SELLING . . .

You will find the names of the buyers of complete systems and components for the military services between pages 23 and 36, and for the commercial services on page F-5.

## MANUFACTURERS AND DISTRIBUTORS . . .

An alphabetical listing of manufacturers whose products are featured in this Guide begins on page 37. A similar listing of distributors serving the aircraft industry begins on page G-1.

## ADVERTISING LISTINGS . . .

Advertisers in the Guide are listed in the Manufacturers' Index, the Distributors' Index and in the Product Listings, and page numbers of their advertisements are shown.

## ADVERTISING PRODUCTS . . .

An index of advertisers, with page numbers of their ads, begins on page H-35. A special index of advertisers' products, beginning on page 62, will help you to obtain complete information on products quickly and easily by referring to the advertising pages.

## TRADE NAMES . . .

A listing of trade names, compiled from data submitted by manufacturers and other agencies, begins on page H-1. This will aid in determining a manufacturer's name if only a proprietary trade name is known.

## REPAIR SERVICE . . .

Further information on all products advertised in the Guide is quickly available. Use the convenient, postage paid card inserts, placed throughout the book, which are keyed to advertisements.

## SECTIONS OF GUIDE

- A: AIRCRAFT.** This section lists products that are controlled either completely or in major systems in an airplane. Powerplants, major components, sub-assembly units or seats or control assemblies that do not fit other items.
- B: ACCESSORIES.** Listings are similar to those in Section A, but are applicable specifically to engines. Specialized supporting equipment is also listed, but complete support items are not included here.
- C: AVIONICS.** The specialized equipment listings in this section include all the electronic gear—radar, transmitters, switches and displays used in the flight controls and computers. On-control systems and specialized units that extend man's knowledge and control of a weapon.
- D: SUPPORTING EQUIPMENT.** The increasing importance of the task of support of a weapon system is recognized by section items from spent in a category of their own, including all the hardware—tools, testsets, raw materials and services that go into supporting functions.
- E: NUCLEAR SYSTEMS.** This section lists not only nuclear weapons units related to nuclear systems, but also the scientific and Government centers of training and operations in this newest science.
- F: AIRLINE AND AIRPORT EQUIPMENT.** In this section are listed the hardware of companies, units and large, that will incorporate the people or cargo, the manufacturing of large fixed items like hangars and runways and lighting systems; and services of airport construction.

## Buyers' Guide

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Weapon  
System  
Breeds  
Specialists

These trains owe their existence to the unique station concept, the complexity of its construction, design failure and the rapid obsolescence of its technology.

These factories have made it imperative that the engineers double as businessmen and lawyers because

• **Technical complexity of new systems**—whether a complete inside or a ready component, an airplane or a flight-line starter and air supply unit for a turbine transport—demands that they be sold by engineers to engineers. Only a specialist having complete familiarity with a design can ask the right questions about a proposed power control using a computer. Only a specialist can have the knowledge to answer questions about the performance change in a turbine fuel unit BPL instead of IP +

\* **Time can be saved and miscommunication avoided** by the direct exchange of technical questions and answers during the engineering purchase of equipment and services. The old route with the salesman and the purchasing agent as middlemen, takes too long to answer. Questions don't have to be referred back to the home plant for cost saving to an engineer for answers to be sent back to the salesman in the field to be relayed to the buyer who must have to find an engineer to interpret the answer.

This isn't just because of the engineering defect. Some engineering concepts, like the classical thermodynamic example of outcrops, can only be defined by using integral calculus or even higher

A dual role has been added to the traditional task of the caregiver as nurturer, developer or disciplinarian.

He has now become both salesman and buyer of the technically complex weapon systems that originally sprang from his drawing board and slide rule.

Around the nucleus of the salesman-engineer or the buyer-engineer has formed an outer ring of sales and purchasing specialists to perform many of the important supporting functions in negotiating contracts, establishing prices and schedules, and following through on deliveries.

These combined teams of specialists, working within a framework built by the emergence of the weapon system concept, have developed a unified approach to the buying and selling fields that could not have been achieved under the traditional approach of scoundrels of functions.

with. Either you understand, and if the system, as you don't. It is as possible as that.

In order to work as a team, the engineer and the salesman on the front must know and understand each other's problems. This is not an easy task for such specialists; the engineer has the design technique, but not the lists of the uses who might want to buy his design. The salesman has the list, but he doesn't understand what he is being asked to sell.

## Bridging the Gap

The 1955-57 Aviation Week Best was given a plumed to help bridge that gap between the specialized knowledge of engineers on one hand and managers and buyers on the other.

material. The first is a series of articles on the techniques of doing business with the media, covering such subjects as the press conference and the press release. The second is a detailed listing of the specific people who buy for the media and industries. The third is a compact, comprehensive listing of the millions of items that help build markets, including artwork, transportation, business plans and musical notation.

But more must be done than strengthening the contractors' organizations in order to shorten the development time lag between concept and production. The direct organizational link between

The services have realized that the

Service-Industry Coordination

At the other end of the scale, the screens are sharing their secrets with the customers, making the solitary requirements known earlier in the game to the designers who must meet them. This has speeded the purchase of research and development.

Companies also have met the need. They have sponsored and attended courses in purchasing techniques, have had symposia between contractor and sub-contractors, have encouraged contact between the engineers and the specialists in buying and selling.

This Services' Center is a new approach born of the weapon system concept: to the understanding and servicing of that huge market.

## Continued High-Level Activity

By Robert Hotz

*The aircraft industry will enjoy another good year in 1957. Gross sales will be close to \$10 billion. While the level of industry output will remain close to its post-war peak, the character of the industry's products is changing due to the rapid advances in technology during the past few years.*

*General outlook for 1957 is for a stable production rate on both military and commercial airplanes and gas turbine engines, with a rising output of guided missiles and avionics systems required in both piloted and pilotless airplanes.*

While gross sales are apt to reach a postwar peak, profits are due for a slight dip for 1957 due to the heavy expenditures being poured out of earnings into research and development facilities and programs. The aircraft industry clearly recognizes that its future depends on pushing at a maximum rate along the whole perimeter of its rapidly expanding technical frontier, and it is taking a larger portion of its earnings than ever before to invest in this future development.

### INCREASED COMPETITION

Another major factor in the 1957 profit picture is the increased competition for military and commercial business that will offer an attractive financial picture for the winners and pose serious problems for the losers of the fierce technical competition for major military weapon systems and commercial transport types. This trend began during 1956, but there will be even wider discrepancies between the profit rates of individual firms in the business than ever before. Profit limiting legislation by Congress or unrealistic application of the reorganization law do not pose any major threat to the aircraft profit picture, although some individual firms may encounter

specific trouble regarding their financial policies.

Military customers—Air Force, Navy and Army—will continue to account for the largest slice of industry sales. Total military sales should be close to \$9 billion during 1957 as several major weapon systems, such as the Convair F-102 all weather supersonic interceptor and the Boeing B-52 heavy jet bomber, hit their peak production levels. Top production levels in major weapon systems is reflected in higher sales throughout the industry's extensive sub-contractor and supplier structure. The military services had an unexpended balance of about \$24 billion at the end of 1956 earmarked for missile weapon systems and supporting system procurement. In addition, the aircraft procurement totals for the Fiscal 1958 budget are due for a major increase over Fiscal 1957.

### COMMERCIAL SALES

Commercial sales, including both airline transports and business flying aircraft, will run close to the billion dollar mark during 1957, but the major increase in this market will not be felt until the 1958-60 period when more than \$2 billion in jet transport orders already on the books are due for delivery.

During this period of increased competition; changing products due to technological pressure; and the exploration of new markets, the industry is also facing major management problems. Time is eating most of the pioneers who built the aircraft industry primarily through the force of their individual characters, and the size and technical complexity of the industry has increased so much during the past five years that a new type of management structure and system is necessary to successfully cope with these trends. Basic reorganization of management structure for most of the major prime contractors in the aircraft

## Spurs Healthy Aircraft Industry

industry is in the cards for the next few years although some firms have already begun this process.

The rising tide of Russian airpower and its growing influence on international affairs; the rapid pace of technical development that is already pushing the industry into the fringes of outer space; and the continued expansion of the international air transport network will continue to be the major influences spurring a healthy aircraft industry.

### TRENDS FOR '57

In addition the following trends will be felt strongly during 1957:

- **Weapon system concept.** The development of a complete weapon system delivered combat ready from a manufacturer's plant to an operational unit is firmly established as both an Air Force and Navy policy. Because of a lack of industrial and technically trained management, both services will continue to delegate more of their managerial authority for development and producing complete weapon system to private industry through the weapon system manager program. This is already leading to a markedly different industrial structure within the aircraft industry and places a premium on development of large vertical-type industrial organizations and makes it more difficult for the small business to find a place in the military market. It may also stimulate a series of mergers in which smaller companies combine to compete more successfully with the established giants in the field.

- **More selective buying.** As weapon systems become more complex and complete, it becomes financially difficult to finance competing systems beyond an early design stage. It becomes more necessary to make a sound technical decision in favor of a single system before the huge invest-

ment in production and production testing is required. This will mean more intensive competition than ever before in technical development. It is the major reason why individual firms are investing so heavily in research facilities such as supersonic and hypersonic wind tunnels, rocket propelled model programs, altitude and climatic chambers and supporting data reduction and computing facilities. An individual firm can no longer rely on government financed or operated facilities in this critical phase of technical development and must have control over its own research and development effort if it is to survive in the increasingly fierce technical competition.

- **Expanding technology.** Advent of gas turbine engines and avionics created a major expansion of aviation technologies during the past decade, but already the industry is plunging into new technologies that dwarf the scope of the technical revolution wrought by the gas turbine and avionics. Among major technologies that are firmly linked to the aircraft industry are nuclear physics applied to propulsion, weapons and weapon delivery systems; communications for the conquest of outer space; new horizons in aerial-berg to meet the requirements of hypersonic flight, and the new era of exotic fuels.

### NEW TECHNOLOGIES

During the next three years, the aircraft industry will still be producing military hardware of the types already well developed, primarily manned strike-fighters, bombers, transports and trainers, with a slowly rising percentage of missiles. Major impact of the new technologies will probably not be felt in terms of large scale business for another three years, but the research and development foundations on which this new business will be based are being laid now.

## Air Force-Army Assess

Washington-Whatever happens in the Fiscal 1975 Defense Department budget-and it is almost certain to increase from 4 to 675 above this year's \$15.5 billion-there are certain inescapable facts that the aircraft industry and its suppliers must accept:

- Despite what they feel is needed in development and limited hardware, the U.S. Air Force and Army Aviation will find money a primary controlling factor in their buying programs.
- Properties of the total budget spent on guided missile systems will dominate. The number of delivered conventional aircraft weapon systems will be reduced, but the total cost of these systems will continue to rise.
- Ease of maintenance, reliability and performance will be the daily drill. Contractors who fail to meet specifications on these points will suffer penalties. The three factors must be given top consideration in the design and construction of everything from a tractor to a five cockpit aircraft.

### Determining Profit

The aircraft industry's customers have a high cost, set of getting what they want. They treated the industrial aircraft market right down through the sub-minorizing structure, and then have the final word in determining profit. The cost of the factory investment in being paid have been reduced by Dredger G. Shop, Assistant Secretary of the Air Force for Material. They include:

- Capacity.
- Quality.
- Adherence to delivery schedules.
- Cost control.
- Risk control.
- Government furnished facilities and financing.
- Contribution to research, design and development.

The Air Force is no anomaly in its these considerations are a formula for determining profit. That too, however, get paid and remain factors that are applied to the contract negotiator.

"Profit," says Shop, "including the determination of the profit factor, is an art and not a science."

The margin of profit on an weapon contract has assumed a great deal of attention in the field and in industry along with USAF, came out of a Congressional investigation into the subject with a commercially accord.

At the same time, the intense interest of the lawmakers who also appropriate the money-under the annual services bill to this day.

Most disagreements center on the question of sales in our north as a basis for establishing profit. Here is what Shop has told industry:

"We live, as you must, on a contract-by-revenue basis. We have traditionally used the cost of sales approach in a loose but reasonable manner to be allowed under a particular contract."

"This is the manner in which industry industry its operations and it facilitates a uniform basis of understanding. This conforms to the Annual Services Procurement Act of 1947, which requires fixed fees in addition to estimated costs and imposes ceilings on fees measured in relation to such costs."

"It is also consistent with the measurement of profits approach set forth in the War Reliance Act. It is considered an appropriate mechanism of the record for the work to be done under a contract."

Sales can be used in a host of ways in measuring profit and contract becomes lost. On the other hand, sales work, which is determinable for only a specific point in time and varies from day to day, is difficult to fit into a formula. It is a basis for determining profit allowance on a contract-by-contract basis."

### Why Air Force Control

USAF also keeps in the eye what industry does with its profits. A contractor who makes substantial account needs to provide on the U.S. government to provide facilities and financing. The other parts a good chunk of that money into development projects, an negotiating what USAF will need, will be favored in the Air Material Command.

These are several reasons why the Air Force wants upon a degree of control over the subcontracting structure. Despite projects from time to time that come out of the mouth of prime contractors, the Air Material Command clings to its concept that it is a living management ability which it gives a prime contract. Let a board of directors, it retains the right to review and amend decisions.

This does not mean USAF wants to interfere with private business, but it does mean a degree of coordination

that would be responsible without such a check.

Major Gen. David H. Bolan, AMC Director of Procurement and Production, says the prime contractor also retains full responsibility both management and technicality, and that AMC limits its role to review for management with USAF staff.

"We recognize," the General says, "that private industry exclusively has the ability to gather together in proper balance and synthesis the many skills and talents which are required for our most a production effort. We are willing to support financially such management effort through its contracts and do not intend to indicate or indicate the managerial responsibility of industry in any way."

However, the Air Force's intense in production extends over a much greater range of products and materials and over a much longer span of time than is significant to an individual company. It is for these reasons that the Air Force must maintain itself in seeing that the contractor's performance is aimed towards and consistent with the Air Force's national objectives."

### New AMC Directs

Here are some major factors that affect the AMC decisions, when it assumes a subcontracting structure:

- Special skills and talents. AMC recognizes that these abilities, which must be utilized in those complex weapon systems, are widely scattered and obviously cannot be concentrated in the plants of a few prime contractors. The work must be done by those elements of industry best qualified to do the work.
- Facilities. Facilities. The subcontractor part like the talent and must be put to work. Duplication of these facilities in prime contractor plants can be justified occasionally from the point of view of the industry as the Air Force.

• **Competitive opportunities.** Prime contracts cannot be placed exclusively on a basis of price competition. The number of potential prime contractors has gone down steadily with the increasing complexity of weapon systems. Many parts of the weapon system, however, can be built by subcontractors with a minimum of prime contractor involvement.

- **Industrial mobilization potential.** Minimum industrial readiness in the

## Military Buying Programs

By Claude Witten

outlet for sales for a structure that can absorb production to support against a long, not to provide an incentive to the industry. With subcontracting coming 30 to 40% of the USAF production total, the industry has preferred a second, deeper cut in subcontracting.

• **Utilization of small business.** It is a national policy to spread the production base to firms which employ fewer than 500 persons, so long as they can do the job well and meet the competition prices.

### Reliability and Maintenance

Aside from these matters of management and price, the paramount concern of the industry and USAF in 1975 probably will be in the area of reliability and ease of maintenance. A weapon system is useless if it won't work, and only experience with the first Chrysler Scout program has stopped USAF wing commanders. Keeping down accident is a strict of combat readiness has been available only to us in 1975.

The Air Force looks back to design, develop and build modern weapons systems, at work days it looks the intent to maintain them.

Here again, the problem is tested back to industry. Reliability and ease of maintenance must be designed into the product. Budget that the Air Force alone, this system has been tested by the Defense Department, which has set up a Directorate of Maintenance Engineering in the Office of the Assistant Secretary of Defense for Logistics.

Dual job of this office is "to contribute to the confidence of the military services by improving the effectiveness and economy of maintenance operations." It is reviewing the problem in every field of defense activity.

At the USAF level, it is known that one-third of all personnel in a buy on maintenance jobs. One pair of your plus distances equipment covers three times of maintenance for every hour in the air.

### Maintenance Cost

In general, the cost of maintaining electronic equipment is twice as much as that in the first cost of the equipment. A New contract can be made in the case of during the life of the equipment is less than the initial cost.

Gen. Bolan has warned:

"Unless significant gains in technology are made, we may well be expending the time when we are developing new production line systems which have not been experienced and tested for reliability."

"This will be an extremely difficult decision to make and has with us a view of the civil world for the aircraft possible support weapons. However, we must at the same time accept the fact that when we do not have reliability, we do not have the ability to fight."

USAF is working with industry in an effort to have reliability and ease of maintenance designed into the weapon system. Most major prime contractors have in recent months set up special engineering groups to learn about the drawing boards and make sure an engine does not have to be removed to replace a fuel line or a wing segment on the air stream.

The importance of these factors must be shown to direct proportion to our progress toward a single aircraft. Huge studies it will be made in this direction in Fiscal 1976, as the transition starts to build.

"We are at the threshold," says Gen. Bolan, "of sustained success in our efforts to reduce maintenance costs. We are making sure that every design decision that we make is based on the fact that the maintenance will be better in the future."

### New Demands

It is clear that this is a threshold for industry as well as military hardware. It is the threshold of a challenge to meet a new set of demands. Here are some of them:

- **Flexibility.** For rocket, target and missile programs they must be able to use locations and old test grounds must be changed or, or salvaged, to keep the overhead system rooms.
- **Performance considerations.** They must be better, better shielding and sound proofing for firing sites.
- **Materials.** Temperature and stresses must be opening, weapons will out date the mobile and delivery today. New uses will be needed for both vehicles and power plants.
- **Production technology.** There is a demand for dimensions, shapes and sizes that cannot be made in today's factories. Increased automation and numerical control are not available options are available.

In the case of all this, we must return to work and the fact inescapable fact-that there is a limit to available funds.

The Aircraft Industries Association, counting today's aircraft costs with those of World War II, has pointed out that there only have been four aircraft in 1952 as low as \$12.2 million in 1955. The index figure for a single aircraft in 1955 was \$12.2 million in 1955. The index figure for a single aircraft in 1955 was \$12.2 million in 1955. The index figure for a single aircraft in 1955 was \$12.2 million in 1955.

### Engineering Effort

The engineering effort involved in making Gen. Bolan's "threshold" is staggering, and the technological problems, named here in complete politeness in the Soviet air displays at 1955, has set the spotlight on this effort. We are among only four of the world, but here are some facts developed recently by a consolidation of light aircraft.

In 1949, the engineering department employed 1,800 persons with a payroll of \$4,675,000. Two years later, the number of employees was 2,400 and the engineering payroll was \$13,462,500. The total volume is equally significant. It dropped three \$17 million in 1944 to \$11.5 million in 1954.

The engineering hours required on a World War II fighter prototype was 123,144. Hours required for a jet fighter prototype rose to the active air category in 1954. The comparison shows that its own production costs prototype will require 2,145,360 hours.

USAF spokesmen are frank that they have assessed at the point where they must be selected. They simply cannot afford to make their choice too late in the program. We are approaching the time when development will be stopped in all but the most promising weapon projects.

The system is simple. We do not have the money or talent or facilities to produce all of them if they did prove technically feasible.

This is why industry capability is paramount and only the most worthy will survive. The successful response to the demand for development will be the one that provides performance along with economy in initial cost and upkeep.

# Navy to Step Up Hardware Buying

Washington—Latest steps in the streamlining of Navy's Bureau of Aeronautics to meet the complexities of modern weapons systems may eventually affect almost every aircraft and component manufacturer.

Although these newest changes are taking place at the research and development end of the spectrum, they are one more indication that nothing in the aircraft/defense industry—down the overall weapon system to its smallest parts—remains static for long.

Adaptation of the weapon system concept and reorganization of the Bureau's research and development activities will not affect the day-to-day nucleus of hardware procurement responsibilities. But it is almost certain to have an impact in the long run.

Greatest emphasis in this recent reorganization (AW Oct. 1, p. 25) has been placed on long range planning—and

on letting industry know a good deal more about this planning.

The whole field of contract administration may come to be viewed in a new light. Rear Adm. William A. Schuchman, Director of Aeronautics, said for research and development "and research."

"We may have to redefine and reassess our methods of some activities

and our methods of contract award. At this point, it is too early to tell whether substantial changes over what the Bureau practices will occur, or whether there will be only refinement of present procedures."

## More Information for Prime

Adm. Schuchman had in mind primarily relations with research and development contractors. But it is obvious that a rapid pace of technological development means that what happens on the research and development and vitally affects production and procurement.

Regardless of what happens in recent activities and contract rewording, effect on the development or production fields, "it appears that the prime manufacturer will come in for a greater

share of participation" in long range planning, Adm. Schuchman said.

This begins with giving the contractor more information about the military requirement and its needs, proving operational analysis," he said. "It implies a greater sharing of the future plans and, in proportion, places a greater charge of responsibility upon the manufacturer."

These new approaches also are "designed to encourage the contractor to make up most basic research of his own to suggest novel government and laboratory efforts to find the best solution to problems in the many fields of our technology."

Adm. Schuchman makes it clear that the contractor who hopes to maximize their cooperation in the future should take part in the "staggered up" exchange of military and technological information—now—and that the interchange will require the contractor to "establish a single focal point for the exchange and evaluation of the state of data."

This attempt at improved communi-

cations with industry has been under way since the reorganization of BuAer (AW Sept. 3, 1955, p. 12).

The need for it was explained by Rear Adm. Robert L. Stuart, vice chief of aerial materiel, shortly after the reorganization began, who said that the manufacturing capacity of the U. S. was then 10% greater than at the beginning of the Korean War. He added that it soon would be 100% greater than at the end of World War II.

"We can expect more companies to be making defense business in the future, and some companies which have been regarded a certain amount of support, with regard to special aspects of defense production may find some competition in some of these fields."

Adm. Stuart said he had found that the "short, specialists and well prepared companies get the business when the time came for the Navy to place a contract, especially in a new field of endeavor."

One result of the general BuAer reorganization was the creation of an assistant chief for procurement, now

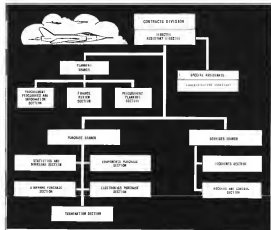
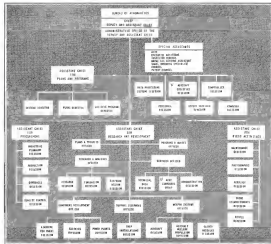
headed by Rear Adm. J. N. Murphy, who would be concerned with contracting, industrial planning, production and quality control.

## Step Up in Procurement

Adm. Murphy told Assistant Chief that procurement procedures have "been speeded up considerably" in the new organizational structure, partly by increasing the contracting staff but primarily by using the concept "that procurement is everybody's business—the engineer's, the requirements people, etc."

Main industrial bidding procurement for large aircraft orders is handled by the Navy Purchasing Office. The Aviation Supply Office at Philadelphia handles procurement of smaller items, evaluation, repair and maintenance, replacement quantities of smaller items, etc.

Adm. Murphy said BuAer's procurement people are maintaining a close liaison with the USAF Air Materiel Command at Wright-Patterson AFB, Ohio—draws the policy level on down.



# ARDC Sparks Technological Progress

By Euseb Clark

**Relevance**—Prevalent in the Air Research and Development Command is located to the south, but vital, or else out of the air weapons spectrum—firm ideas to prototypes.

ARDC's mission of providing quality technical support to the Air Force is a potential crisis, has shown strong technological progress demands that it prevent the highest in technical non performance and then use that resource wisely.

To get the best in technology and development work and to do the most with it, ARDC has made a tremendous effort in the past year and a half to tell service and industry what Air Force's needs are now, what they are likely to be in the future and how the ARDC-industry team can fulfill them.

This is a two-pronged effort. In addition to telling industry more, ARDC has solicited industry's ideas much more frequently than in the past.

The research for effective communication between ARDC and the scientific talents of the nation's civilian ARDC aerospace and personnel corps estimate that industry employs two-thirds of the 250,000 people working in the production of aircraft, missiles and spacecraft and three-fourths of the nation's 780,000 engineers.

## Research and Development

Although some of the most important research and development work contributing to a superior Air Force is done at the 11 ARDC centers, more than three-fourths of the ARDC's total effort is done as contract by civilian research, private research groups and industrial firms.

The contract areas in contract points for contractors, give guidance through the life of the contract and in many cases, provide facilities where ideas can be explored and developed into prototypes.

ARDC breaks its mission down into two broad areas—a Technical Program and an Operational Program. The Technical Program, which begins with research and goes into technical development, development of weapons and systems needed 10 to 15 years from now. The Operational Program is basically concerned with weapons systems that will go into the Air Force inventory in the next seven or eight years.

To augment science and industry

with its thinking ARDC uses three efforts to do this:

## Industry Contacts

• **Technical Program Planning Documents**. These are classified studies that establish and delineate the Air Force's technical requirements and objectives for a period that might be called the intermediate future. This covers 40 broad functional areas such as strategic bombing, aerial guidance, electronic countermeasures, etc.

These documents define the job the Air Force will have to do in two to three decades from now, evaluate present technical capability in the area with which they deal and make limitations of current technical and technological support personnel resources, proposed concepts and suggested approaches, and present ARDC's technical requirements and performance objectives.

Generally, Technical Program Planning Documents were distributed to contractors selected for ARDC by the Air National Command ARDC Source Selection Board. Now, however, ARDC is soliciting queries and reports from potential sources of research and development who are not currently contracting with USAF.

Progress should be directed to Commanders of the Air Force, the Department of Defense, P.O. Box 1345, Ballston 7, Md. Attention: DRDID, Development Plans and Program, Director of Development.

• **Workshop Studies**. Requirements. These requirements, now being referred to qualified contractors within the existing activity framework, are an attempt to get ideas in an ARDC's planning efforts. ARDC's efforts at partially a sketch stage—an attempt to get industry to do some of its own research and development, but it also encourages the old practice of doing business in classified areas. Formerly, contractor needed a contract in order to get information, and he needed information in order to get a contract. Distribution of the Technical Program Planning Documents depend upon a "need to know," which ARDC defines as military, plus a capability to participate in the research and development effort.

ARDC does not use a company's role as a criterion for engineering or design, but in discussing the requirements. Contractors can be assigned by, returning to the Program Plans and Policies Office (DRDPP) at ARDC headquarters. Requesters attempt to explain what the Air Force wants to know about potential future weapon systems or, what the contractor affects the area or

area in which he thinks he can make a contribution.

• **Technical Program Synopses and Weapons Systems Conferences**. Basically these are synopses of the philosophy behind the TPFDDs and WSR—a philosophy of comprehensive, integrated ARDC-industry effort, based on mutual confidence.

Every seven to eight months for improving industry's communication with the Air Force and understanding of its needs is the office of Executive for Technical Research, located in the Directorate of Procurement at ARDC headquarters.

Headed by John Eskin, the ESB is establishing what amounts to a one-stop contracting service for new business at each ARDC center and at four ARDC Field Development offices—New York, Los Angeles, Boston and Chicago. There will be a Small Business Specialist at each location. At the center, they will be located administratively on the staff of the Directorate of Procurement.

Small business is defined in this case as a firm that is not dependent on its field of operations and which, together with its affiliates, does not employ more than 500 persons. In addition, ARDC will accept as a small business any firm that is on the Small Business Act exemption.

ARDC is currently looking for all sources of technical competence. Although contractors are usually well acquainted with a contract—small work and associated—information on how to join the growing list of ARDC contractors is available both at center and at ARDC headquarters.

## Areas of Interest

Lots of Air Force areas of interest in research and development and armaments are listed in the following areas: a capability can be obtained from Contractor Relations Officers at the center, from the Office of Industry Relations in Ballston, or by writing to Commanders, ARDC, Box 1345, Ballston 7, Md. Attention: DRDPP.

To protect superior air weapons systems as a small product, the Air Force must understand the government's objectives in the beginning. In the case of ARDC, of course, this means providing the talent of the man in the organization with which it deals.

The contract and the government's objectives at headquarters and the contractor both the completeness of a potential research and development contractor, his approach to the problem.

# Services List Nine Contract Types Governing Buying of Military Items

One of the major responsibilities of the negotiator is the selection of the type of contract best suited to the acquisition which he is negotiating. His choice will have an important effect on the ultimate cost of the contract, on the incentive given the contractor to use materials and manpower efficiently, and on the nature of the response which must be received from the government of the contract. While only negotiators of the contract, the contractor is also involved in the negotiator should not hurry the decision on the contract type to be used. This decision will be based on a number of factors: the nature of the procurement, the contractor's previous and current experience, the degree of competition, the availability of competitive cost data, the complexity of business, and the nature of the contract which the contractor is negotiating. It is desirable to avoid a premature decision, because the nature of the negotiation will be considerably influenced by the type of contract contemplated for use.

Under certain circumstances it may be desirable to obtain quotes from contractors in making the selection of contract type. In such cases, the contractor's cost data, of only one type of contract is considered and quoted upon and it, during negotiation, the price establishment, a new contract proposal undoubtedly will be required, and much time and effort will have been wasted.

If it were always possible to establish firm prices which were fair both to the contractor and the government, the determination of the most suitable type of contract would be no problem. A firm fixed price contract would be used for all procurements. But the determination of firm prices is rarely done and much time and effort is lost in negotiating, talk.

For this reason, several major types of contract have been authorized for use by negotiators, as well as a number of specialized types designed to meet specific situations.

## 1-1 Firm Fixed Price Contracts

- Explanation**
  - (i) Supplies or services are furnished at a specified firm price regardless of actual cost of performance.
  - (ii) When usual cost estimates are possible.
  - (iii) Government-type items are available.

- Advantages**
  - (i) Military-type equipment produced on which relevant production and cost experience are available.
  - (ii) When a contractor desires to share costs of a Research Contract.
  - (iii) When maximum risk and responsibility upon the contractor is desirable, results in the greatest incentive for cost reduction.
  - (iv) Easiest and least costly type of contract to administer.
  - (v) Disadvantages
    - (i) Price may include excessive allowance for contingencies.

## 1-2-A Incentive Fixed Price

- Explanation**
  - (i) Supplies are furnished at a incentive base price (target price) upon completion of the work the price is determined based on the contractor's actual costs plus a sharing of profit which varies inversely with the cost. The relationship price cannot exceed the ceiling price stated in the contract.
  - (ii) Disadvantages
    - (i) When production is spread over a relatively long period.
    - (ii) When difficulty is encountered in negotiating a firm fixed price under the anticipated production conditions.
    - (iii) When target costs can be established suitable or at its early stages, the point with substantial accuracy.
  - (iii) When reasonable opportunities for cost reduction through contract or efficiencies exist.

## 1-2-B Flexible Fixed Price

- Explanation**
  - (i) Supplies are furnished at a incentive price which is determined upon (subject to a ceiling) as determined by a specified percentage of the work has been completed. The final price is based on actual costs incurred to point of termination, plus estimated costs to complete.

- Advantages**
  - (i) Government reserves "flexibility" cost information valuable in negotiating follow-on procurements.
  - (ii) Encourages cost reduction by contractor.
  - (iii) Government shares in contractor's cost reductions.
  - (iv) Government reserves "flexibility" cost information valuable in negotiating follow-on procurements.
  - (v) When saving the ceiling, the sharing point, and the profit sharing formula, contract can be adapted to fit many situations.

- Disadvantages**
  - (i) Contractor has less incentive than under a firm fixed price contract.
  - (ii) More costly and difficult to administer than a firm fixed price contract.

## 1-2-B Maximum Price

- Explanation**
  - (i) Supplies are furnished at a maximum price which is determined determined only after a specified percentage of the work has been completed. The final price is based on actual costs incurred to point of termination, plus estimated costs to complete.
- Use**
  - (i) When sound cost estimates cannot be made at the beginning of the work, but can be made after a certain minimum percentage of the work has been completed.
  - (ii) Repetitive work so that cost estimates in first period periods assume perfection of completion costs.
  - (iii) Work extended over a sufficient period of time to permit determination before completion of contract.

## C Advantages

- Disadvantages**
  - (i) When sound cost estimates cannot be made at the beginning of the work.
  - (ii) Final price is based on additional cost information.
- Disadvantages**
  - (i) Up until the time of termination, contractor has little incentive to keep costs low.
  - (ii) Because of time lag between point of termination and re-determination negotiations, contractor not only has later cost information than negotiator, but may have considered a very large percentage of the work.
  - (iii) More costly and difficult to administer than a firm fixed price contract.

## 1-3-A Fixed Price with Escalation

- Explanation**
  - (i) Supplies are furnished at a incentive price which is determined upon (subject to a ceiling) as determined by a specified percentage of the work has been completed. The final price is based on actual costs incurred to point of termination, plus estimated costs to complete.

- Advantages**
  - (i) Government reserves "flexibility" cost information valuable in negotiating follow-on procurements.
  - (ii) Encourages cost reduction by contractor.
  - (iii) Government shares in contractor's cost reductions.
  - (iv) Government reserves "flexibility" cost information valuable in negotiating follow-on procurements.
  - (v) When saving the ceiling, the sharing point, and the profit sharing formula, contract can be adapted to fit many situations.

- Disadvantages**
  - (i) Contractor has less incentive than under a firm fixed price contract.
  - (ii) More costly and difficult to administer than a firm fixed price contract.

interest in material prices and labor costs and in the quantity of material or labor required.

#### B. Use

(a) When increases or decreases in specific costs rise as material prices or labor rates go beyond the control of the contractor.

#### C. Advantages

- (a) Government avoids paying for contingencies that do not occur.
- (b) Privately fixed price contracting even if contract cost elements are subject to accurate prediction.
- (c) Disadvantages
- (d) Government assumes part of contractor's risk.
- (e) Additional administrative problems.

### II-1. Cost-Plus-Fixed-Fee

#### A. Explanation

(a) Supplies or services are furnished at actual cost plus a fixed fee which is based on a negotiated percentage of the original estimated cost.

#### B. Use

(a) When it is impossible to estimate costs with any degree of accuracy.

#### C. Advantages

- (a) Government avoids paying for

contingencies that do not occur.

(b) Profit not based on costs in contractor has no incentive to pad costs.

#### D. Disadvantages

(a) Contractors have little incentive to reduce costs.

(b) Must carry type of contract to administer.

### II-2. Cost-No-Fee

#### A. Explanation

(a) Supplies or services furnished at actual cost with no fee as profit allowed.

#### B. Use

(a) When it is impossible to estimate costs with any degree of accuracy. Primarily used with educational and nonprofit organizations.

#### C. Advantages

(a) Government avoids paying for contingencies that do not occur.

(b) Profit not based on costs in contractor has no incentive to pad costs.

(c) Must carry type of contract to administer.

### II-3. Letter Contract

#### A. Explanation

(a) A written, preliminary contractual instrument which authorizes immediate commencement of manufacture of supplies, or performance of services, including but not limited to, preproduction planning and procurement of services materials.

#### B. Use

(a) When estimates of national defense demand contractors have no binding commitments to that work can be commenced immediately.

(b) Negotiation of a definitive contract in sufficient time to meet procurement need is not possible.

#### C. Advantages

(a) Quick contractual coverage.

(b) Competition required, when possible.

(c) Time lag before conversion to definitive contract.

(d) Government assumes part of contractor's risk.

(e) Government assumes part of contractor's risk.

(f) Government assumes part of contractor's risk.

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(u) Government assumes part of contractor's risk.

Contract and Production Development and Growth Account, Dept. of Defense, Office of Defense Production, 1215 Clay Street, Oakland, Calif. 94612. (415) 774-1000. (415) 774-1001. (415) 774-1002. (415) 774-1003. (415) 774-1004. (415) 774-1005. (415) 774-1006. (415) 774-1007. (415) 774-1008. (415) 774-1009. (415) 774-1010. (415) 774-1011. (415) 774-1012. (415) 774-1013. (415) 774-1014. (415) 774-1015. (415) 774-1016. (415) 774-1017. (415) 774-1018. (415) 774-1019. (415) 774-1020. (415) 774-1021. (415) 774-1022. (415) 774-1023. (415) 774-1024. (415) 774-1025. (415) 774-1026. (415) 774-1027. (415) 774-1028. (415) 774-1029. (415) 774-1030. (415) 774-1031. (415) 774-1032. (415) 774-1033. (415) 774-1034. (415) 774-1035. (415) 774-1036. (415) 774-1037. (415) 774-1038. (415) 774-1039. (415) 774-1040. (415) 774-1041. (415) 774-1042. (415) 774-1043. (415) 774-1044. (415) 774-1045. (415) 774-1046. (415) 774-1047. (415) 774-1048. (415) 774-1049. (415) 774-1050. (415) 774-1051. (415) 774-1052. 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\*Reviewed for all 11 May 2010; accepted 16 June 2010 after minor revisions

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Most important of these are the Navy Purchasing Officer.

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Officer in Charge, Drug Purchasing Office, 1140  
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Executive Officer, Drug Supply Center, 1001 West

Country	Species	Year	Sex	Age	Weight (g)	Length (mm)	Wing (mm)	Tail (mm)	Bill (mm)	Foot (mm)	Claw (mm)
Germany	Starling	1950	Male	Adult	100	150	70	50	15	15	5
Germany	Starling	1950	Female	Adult	90	140	65	45	15	15	5
Germany	Starling	1950	Male	Adult	110	160	75	55	15	15	5
Germany	Starling	1950	Female	Adult	95	145	70	50	15	15	5
Germany	Starling	1950	Male	Adult	105	155	72	52	15	15	5
Germany	Starling	1950	Female	Adult	92	142	68	48	15	15	5
Germany	Starling	1950	Male	Adult	108	158	74	54	15	15	5
Germany	Starling	1950	Female	Adult	98	148	71	51	15	15	5
Germany	Starling	1950	Male	Adult	112	162	76	56	15	15	5
Germany	Starling	1950	Female	Adult	94	144	69	49	15	15	5
Germany	Starling	1950	Male	Adult	106	156	73	53	15	15	5
Germany	Starling	1950	Female	Adult	96	146	70	50	15	15	5
Germany	Starling	1950	Male	Adult	114	164	77	57	15	15	5
Germany	Starling	1950	Female	Adult	99	149	72	52	15	15	5
Germany	Starling	1950	Male	Adult	116	166	78	58	15	15	5
Germany	Starling	1950	Female	Adult	101	151	73	53	15	15	5
Germany	Starling	1950	Male	Adult	118	168	79	59	15	15	5
Germany	Starling	1950	Female	Adult	103	153	74	54	15	15	5
Germany	Starling	1950	Male	Adult	120	170	80	60	15	15	5
Germany	Starling	1950	Female	Adult	105	155	75	55	15	15	5
Germany	Starling	1950	Male	Adult	122	172	81	61	15	15	5
Germany	Starling	1950	Female	Adult	107	157	76	56	15	15	5
Germany	Starling	1950	Male	Adult	124	174	82	62	15	15	5
Germany	Starling	1950	Female	Adult	109	159	77	57	15	15	5
Germany	Starling	1950	Male	Adult	126	176	83	63	15	15	5
Germany	Starling	1950	Female	Adult	111	161	78	58	15	15	5
Germany	Starling	1950	Male	Adult	128	178	84	64	15	15	5
Germany	Starling	1950	Female	Adult	113	163	79	59	15	15	5
Germany	Starling	1950	Male	Adult	130	180	85	65	15	15	5
Germany	Starling	1950	Female	Adult	115	165	80	60	15	15	5
Germany	Starling	1950	Male	Adult	132	182	86	66	15	15	5
Germany	Starling	1950	Female	Adult	117	167	81	61	15	15	5
Germany	Starling	1950	Male	Adult	134	184	87	67	15	15	5
Germany	Starling	1950	Female	Adult	119	169	82	62	15	15	5
Germany	Starling	1950	Male	Adult	136	186	88	68	15	15	5
Germany	Starling	1950	Female	Adult	121	171	83	63	15	15	5
Germany	Starling	1950	Male	Adult	138	188	89	69	15	15	5
Germany	Starling	1950	Female	Adult	123	173	84	64	15	15	5
Germany	Starling	1950	Male	Adult	140	190	90				

[illegible]

deli, small pastries, pastries, small pastries,  
squares, small, light cheese, soft and light,  
the same, the same, the same, the same.



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Survey of American Art, 1880-1910.  
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**Sarkes Tarzian**

## SILICON and SELENIUM Rectifiers

Sarkes Tarzian uses two types silicon rectifiers are made by a special process that provides optimum forward and reverse resistances and long useful life. Current ratings for half wave applications range from 500 milliamperes to 15 amperes dc and multiple ratings per unit range from 50 to 400 milli amp peak average. Small size coupled with high efficiency and excellent high ambient temperature make silicon rectifiers the practical component for most applications that require dc power. Our staff of competent power conversion engineers is ready to consider your applications for prompt recommendations. Write, wire or phone.

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**Type B**—Type B silicon rectifiers are used at 100°C maximum or with peak average currents of 100 to 1000 mA. They are used in a wide range of applications where low forward and reverse resistances are required. Low and medium power applications.

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### A Rectifier for Every Application

A wide selection of selenium rectifiers designed to afford the design engineer by the Sarkes Tarzian line. It is possible to provide ratings of up to 100 amperes in thousands of amperes and from a few volts to thousands of volts by using series, parallel and series parallel arrangements. Whatever your power conversion problem write for specific recommendations for your applications.

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Remember—whatever your problem on power conversion, the Sarkes Tarzian Rectifier Division engineers provide you with the practical answer. Send for your copy of the Selenium and Silicon Rectifier Handbook.

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SILICON and SELENIUM Rectifiers



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# Patterns of Progress in Pneumatics

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1957 AVIATION WEEK BUYERS' GUIDE

SECTION

**A**

# Speeding Air Weapons Development

By Paul A. Wilbur

*Associate to Deputy Director, Procurement and Production  
Headquarters, Air Materiel Command*

*Because of the increasing importance of the time factor in the development of our weapons, progress must be in the maintenance of our aerial weapons superiority, and because of its impact on the aircraft industry, Aviation Week publishes this analytical and comprehensive summary.*

All of us who have taken part in the tremendous advancements over the past several years are aware of their impact upon our scientific, engineering, manufacturing and managerial skills.

We have seen the increase in performance requirements pull into our programs as everwidening spans of effort. Our inventive genius has been stretched to substitute electronic processes for human calculations and reactions. The speeds, altitudes, positions and kill probabilities of our weapons have made this necessary. This has required bringing together, on a most intimate basis, separate schools and disciplines of science, knowledge, engineering and development.

The advance in weapons performance has done several things to our tactics approach to weapons development and production. First, and most importantly, is the vigorous pushing of the rate of the effort to achieve our performance goals. This has been characteristic of our activities across all the sciences—aerodynamics, thermodynamics, physics, electronics and metallurgy.

In working so close to the frontier of knowledge we have had to make many extrapolations and predictions which have involved uncertainty of success and high risks of time and funds investment.

## Major Changes

This has resulted in a sharp increase in the number of articles required for testing and evaluation.

Conceptually, no one can no longer prove a new weapon with only one or two test vehicles. We must achieve fast production almost concurrently with development in order to get the weapons 12 to 18 vehicles for test. These numbers are required so that we can concurrently evaluate each separate technical advance necessary for various performances.

A second major change in the future system is the fact that the development production time-span for the more complex subsystems such as fire control systems, bombing navigation systems and offensive and defensive armaments are much longer than that shown for the air vehicle itself. Our failure to recognize and get on top of this problem earlier than we did led to many deficiencies in the quality of our inventory armaments. It also has seriously aggravated our reliability problems through the pressure to begin test too.

A third relatively new factor in the total situation is the emergence of missile technology. We are having to over-

sees development and production for both manned and unmanned weapons. This has produced multiple loads of both the government and industry loads. In addition to multiplying the project load, it has increased tremendously the number and area of inter-industry and industry-government co-ordination points. This, too, has added to the length of time of our total program.

When these broad outlines of our problems, let us turn to the speaker of what has been done and what remains to be done.

Within the past two years the Air Force has introduced more changes and innovations to speed up its part of the work and to open the door to improve results by industry.

## Research and Development

Our first efforts have been in the area of research and development. Here, we see the problems as being two-fold. First, we must make the best use of talent and skills devoted to weapon technical problems. Secondly, we must guide and direct that talent towards both general and specific goals to meeting our requirements.

We are making available to any qualified individual, firm or institution our long-range planning of technical requirements. We are building our documents which show our criteria, of the present state of the art, the desirability of additional research and develop-

ment and the expected levels of performance to be required over the next several years.

Headquarters ARDC at Baltimore would be more than pleased to furnish complete details on this program.

Purchasing this program, ARDC is also distributing to our major weapons producers the advance planning for future weapons requirements. From these the new generations and families of new weapons will be born.

To maintain and support these plans and requirements needed, ARDC is holding periodic Technical Symposia at various locations throughout the country. The purpose of these Symposia is to provide a forum for the exchange of progress and development information and of new trends in requirements.

These data and technique materials will provide to the opportunity to meet their needs for advancements as well as a timely basis. If we take maximum advantage of them we should save months and perhaps years in accelerating our programs.

## Selecting Weapon Systems

A further critical change we have made is in the manner of selecting new weapon systems. Our former practice of getting a new weapon was rougher than:

When a new requirement was established we placed with all interested engineering design study contracts a detailed technical description. At these were completed, we undertook to evaluate them in our laboratories and in the program selected the most promising design. This design was then offered competitively to industry for submission of development proposals.

From these development proposals the most promising—those the standpoint of meeting our requirements for performance time and cost—was selected and the contract awarded.

This process continued from one and one-half to five and one-half years. Aside from the inevitability of these extended time spans other things were happening to us. Throughout this time there were continuous changes in the state of the art and frequent changes in requirements growing out of these advances. The result was that we did not build the correct burden of reflecting all that an specifications cost, labor, work, etc., etc., change orders and other things per week.

Today, for our important systems, we are going about it in this way:

When a new requirement is established, the ARDC and the AMC go hand, through the Source Selection



Val-Aero Divisor  
Pneumatic & Hydraulic Valves



Gyro Dynamics Divisor  
Auto Gyros



Major Assemblies



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is to



# AIRCRAFT AND MISSILE CONTROLS



The components shown here are but a small cross-section of the entire range of products we design and manufacture. Many variations of these units have been created to suit specific requirements. A large part of our design effort is also devoted to the development of complete control systems having outstanding performance and reliability.

We invite you to discuss your present and future requirements on components or control systems with our engineering staff. Data sheets for current models are available. Please direct your inquiry to our plant at Danbury, Connecticut.



High Temperature Switch, Type 425N

High Temperature Switch, Type 425N  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F



Pressure Switch, Type 425N

Pressure Switch, Type 425N  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F



Pressure Switch, Type 425N  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F



After Burner Fuel Control, Type 141H37

After Burner Fuel Control, Type 141H37  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F



Pressure Switch, Type 425N  
Operating Range: -40° F to 1000° F  
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Operating Range: -40° F to 1000° F  
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Pressure Switch, Type 425N  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F

## "WATERLOO" Temperature Measuring Probe

"WATERLOO" Temperature Measuring Probe  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F



Pressure Switch, Type 425N  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F  
Operating Range: -40° F to 1000° F

## MANNING, MAXWELL & MOORE, INC.

AIRCRAFT PRODUCTS DIVISION • DANBURY, CONNECTICUT • INGLEWOOD, CALIFORNIA  
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CORP.  
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#### LANDING GEAR

Overcoming example of Ladish heavy drop forging: 1000 pounds, 100 inches in length, drop forging control material and mounting post for 1000 pounds of Chrysler-Wheeler-Williams alloy steel.



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Again Ladish pioneers with the largest known titanium forging produced in closed-impression dies, 1000 lbs. weight, 100 inches in length, 100 inches in diameter.

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1000 pound titanium steel drop forging, 100 inches in length, 100 inches in diameter, 100 inches in length, 100 inches in diameter, 100 inches in length, 100 inches in diameter.



**WITH CLOSED-IMPRESSION-DIE  
DROP FORGINGS WEIGHING UP TO**

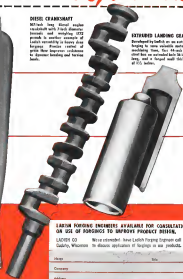
**10,000 LBS.**

#### DESEL CRANKSHAFT

100-inch long diesel engine crankshaft with 10-inch diameter journals and weighing 10,000 pounds is another example of Ladish capability in heavy drop forging. Precision control of grain flow improves resistance to dynamic loading and torsion loads.

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GUTHRIE, WISCONSIN

We're interested. Send Ladish Forging Engineers call to discuss application of forgings in our products.

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FOR COMPLETE SERVICE IN FORGINGS

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1. Compulsory scheduled period of signal and instant point
2. Non-reflective surfaces
3. Excellent anti-glare capability
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7. Optional mounting brackets

Send for detailed catalog!

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COMPANY

Manufacturers of most Marco parts.  
Indicates whether double circuit and latching.

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## KOHLER PRECISION CONTROLS

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Kohler Co., Kohler, Wisconsin. Established 1873

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Kohler Co. maintains in one plant a precision-skilled organization with complete facilities for forging, casting, machining and finishing.

Kohler engineers will gladly assist in developing controls to specification for volume production. Write for complete information.

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PIPE AND TUBE	PIPE AND TUBE
PIPE AND TUBE	PIPE AND TUBE

Here you see just a few of the hundreds of complicated precision components and assemblies being supplied to the aviation industry by Weatherhead. Ability to tackle and solve complex problems is evidenced in the nature and range of these products.

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## CAN SOLVE YOUR AIRCRAFT TEMPERATURE PROBLEM?

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Fenwal Fire and Over-Heat Detectors protect every type and size aircraft. Made for single-wire and double-wire loop circuits, Fenwal Detectors are a loop circuit act independently in the event of electrical breakage in the electrical conductor. One push-button electrically disconnects wiring to either type of circuit.

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Compact, easy to install, Fenwal Aircraft Heater Controls are highly resistant to shock, vibration and extreme temperatures.

As in all Fenwal thermocouple<sup>®</sup> units, the outer shell is the temperature-sensitive element that activates internal contacts the instant act point is reached.

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### THESE COMPONENTS IN ONE SYSTEM



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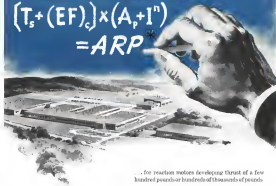
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- T<sub>s</sub>** ..... skilled technicians  
**(EF)<sub>c</sub>** ..... complete equipment and facilities  
**A<sub>p</sub>** ..... past accomplishment  
**I<sup>n</sup>** ..... unlimited imagination  
**ARP** ..... advanced rocket power

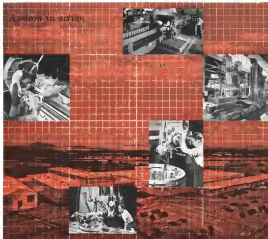


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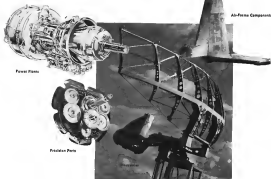
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Mobile Section  
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Designs available for USAF Models MV-1A, MV-2, MV-3, and other similar trolley mounted air conditioner units.

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## "MONOBALL" Self-Aligning Bearings



### CHARACTERISTICS

#### ANALYSIS

- 1 Light Duty Self-Aligning Ball Bearing
- 2 Heavy Duty Self-Aligning Ball Bearing
- 3 Extra Heavy Duty Self-Aligning Ball Bearing

#### RECOMMENDED USE

- 1 For types requiring high speeds (over 100,000 rpm)
- 2 For types requiring moderate speeds (10,000 to 100,000 rpm)
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Thrust loads to use. Standard for years of service life. Wide variety of Plain Types in bore sizes 1/16" to 6" Dia. Ball and Tapered Roller types in 10 individual specifications. As a result of thorough study of different operating conditions various steel alloys have been used to meet specific needs. Write for detailed Engineering Manual describing complete line. Address Dept. A-100

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**Stress Types:**

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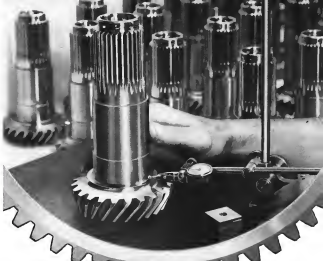
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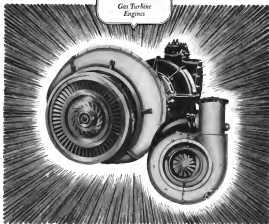
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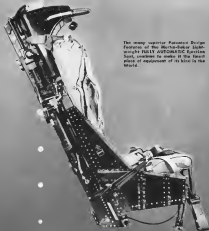
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## MISSILES



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1957 AVIATION WEEK BUYERS GUIDE

SECTION

**B**

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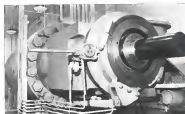
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## Missile Development Hinges on Ideas

By David A. Anderson

The military services don't buy missiles; they buy ideas that will someday become missiles.

Failure to understand this particular approach to the purchasing and sales of technically complex weapons has left more than one hopeful contractor no longer hopeful.

The biggest mistake made by suppliers of the thousands of "hardcore" ideas that go into a missile as a conventional aircraft is that they delay too long. Instead of meeting with the designers while the aircraft is in the design stage, they wait until production has started and then try to climb on board. The result: All the components and hardware have long since been specified and unless something goes wrong with one of them, there are no future orders.

This situation is a very real one. Only months ago one of the nation's biggest manufacturers of a dynamic product line made a survey of the guided missile portion of the aviation industry. Their own view was "I got it on the ground floor of the missile business." What they didn't realize was that they were about to have to learn to grab some space on the roof.

The situation is not unique for missiles. It applies to any complex, intensively technologically weapons system or transportation system. It holds for the ballistic propellant and the rocket engine, the SCRM and the cruise missile, etc.

For example, the Douglas Thor IRBM is in the testing stage; the first round was scheduled for firing earlier this month. By the time the test program is completed, the results have been analyzed and the specific problems against the Army's Jupiter IRBM, one year will have passed. The testing, building to endurance and the like will take another year or more. By the time the missile is in production, it may be 1968.

But the past years into the missile in 1960 were specified and constructed in 1957.

### Production Program

Another little-understood aspect of the missile field is the rate of build-up of production. Most people think in terms of prototypes which are fired and followed by a few more prototypes. Each of these is a hand-built vehicle, man-made completely different from the one we believe it, sometimes only slightly different.

Really we are two by the side. During the life of this development program, the entire missile design is a shifting state. Components are replaced, redesigned, reworked, reworked. But gradually the missile prototypes

settle down into a form that will define the aircraft's production program.

When the order is given to go from prototype to production, the missile is frequently built at that stage of its design, with no changes to be made in the subsequent build in actual use.

Here again, those readers and suppliers who are asked to stay with the production program.

The current rate of military spending for missiles is about \$1 billion dollars. Only one of military spending, then or only an estimate. The reason is that it is almost impossible to measure research and development costs against specific projects at even \$100 million. Another factor is that in some cases, missile development is lumped in with aircraft, or even ammunition.

It has taken more than a decade to reach the billion-dollar mark. During major commitments, the level of military spending for missile weapons should be over the next few years to an estimated \$2.5 billion in 1968. These should be a shift in funds from research and development to production in the near advanced stages, today in test, become production weapons.

Of this amount, the earliest portion is allocated for actual missiles. The largest chunk—estimated as high as 60%—goes for the development program required to identify targets and close on them. Another large allocation goes to the supporting system that are needed to make the missile an operational weapon instead of a laboratory test vehicle.

Current emphasis is on increasing

of existing weapons such as the Army's Nike and Corporal, the Air Force's Hawk and Malmstrom, and the Navy's Sparrow and Terrier.

The military services have integrated some of their own weapons into field service use and are rapidly mounting operational training exercises that will be the necessary foundation of more complex systems to come.

The Air Force, for example, is equipping its interceptors with the Hughes Talos, an air-to-air missile, available that has demonstrated high kill power. The Martin Matador, a medium-range surface-to-surface tactical missile, has been worked into squadron use and deployed in Germany with tactical air power.

The Navy has equipped two cruisers and one destroyer with its own missiles. By 1975, its first ship will be equipped to handle the Bumble Bee, long range surface-to-air missile for area defense of the fleet. Within five years the Navy will be operating five of these Talos-equipped ships, and an additional fleet of 17 cruisers with Conquest-Tarantula and 12 smaller ships—probably destroyers—with Conquest-Tarantula missiles.

The Army, spending Nike batteries at more than 100 sites over the U. S., has sent field artillery battalions to Europe equipped with the Pioneer-belt Corporal surface-to-surface missile. Most John Field artillery rockets have also been replaced by the new Army's The Chrysler-built Redstone, 200-mile ballistic missile, is almost ready for use in the troops.

### In the Works

To cover the big extended-range ballistic missiles (IRBM) now being developed by the Air Force by Douglas (Texas) and for the Army by the Army Ballistic Missile Agency (Alabama). The Jupiter program was a joint effort by AECMA and Navy to develop a missile that would meet the requirements of both the Army and the Navy. The recent decision issued by Secretary of Defense Wilson has raised the operational responsibility of Jupiter from the Army.

After these, or perhaps parallel to them, will be the big ones—the intercontinental ballistic missiles (ICBM). General's Atlas and Minuteman's Titan are both being carried through the development phase of the Air Force. In the future a choice will be made between the two.





## AVIONICS



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1957 AVIATION WEEK BUYERS' GUIDE

SECTION

C



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# Avionics: Industry Talent Not Utilized

By Philip J. Klein

Large avionics manufacturers, widely besting the bushes for more engineers to expand their research and development effort, may be overlooking a more immediate, and possibly more rewarding, solution.

This is to turn out more of their small subsystem and component development efforts to the domain of small avionics firms which are competent in specialized fields.

A few examples will illustrate the fact that this approach is not being fully exploited.

- One division of a large avionics company is building digital computer systems to be used by its own customers in this field for use in a new navigation system under development. Meanwhile, one of its other divisions in the same company, with considerable experience in the airborne digital computer field, is out searching for work. The justification: It's "too much trouble" to coordinate the development because the same division is 3,500 miles away.

- A major avionics company is developing its own digital control system for a new flight control system, though there are more than a dozen small firms in the field. Their performance there was nothing available that would meet the required accuracy.

## Justifications

These justifications of "too much trouble to coordinate" and "nothing available" are the ones most often heard. Behind these explanations may be another which is seldom voiced: A large company's corporate goals make it reluctant to sub-contract out a small subsystem development when it has the competence in-house. It could possibly compromise the competitive performance of the total effort.

In some instances industry managers have recognized that in a time of expensive shortages it is not a question of whether they can do the job. Rather, it is a question of whether a competent job could be done outside, leaving company engineers far from fruitful efforts.

## For example

- Westinghouse Air Arm Division several years ago recognized the trend to digital computers for fire control systems and its own lack of experience in this field, and sub-contracted out the development of an advanced digital computer to the then small Rayco-Woodbridge Corp.

- General Electric's Light Military Electronic Equipment Dept. decided to subcontract the development of the external portion of its new Display

of problem. When, in the course of developing an advanced complex system the need for new components or sub-system development becomes evident, it is all too easy to launch such development within the company.

It requires close engineering supervision to get these links in the development program and where work could be sub-contracted, and policy must be determined whether the added development burden should be shouldered in the company or turned out.

One important consideration in making such a decision is whether the characteristics of the component or job system can be adequately defined or whether they may change in the act of the small system design. The latter situation makes sub-contracting of research and development more difficult but certainly not impossible.

Some recent manufacturers have argued that they might be doing the sub-contracting right control system for their own aircraft because the system's characteristics must be closely tailored to replace characteristics and form factors, both of which can change frequently during aircraft design.

Despite this, many avionics companies have successfully bridged the difficult coordination problem to provide complete, automatic flight control systems. This suggests that design coordination, even when parameters are difficult to fix, is largely dependent upon the degree of task parties and their ability to provide close management of the R & D effort.

## Specialization

Although it is a rule natural for a large avionics company to be reluctant to avoid corporate lines and resources should enable it to do a better job in developing a new "gizmo" than a small firm with only a few dozen engineers.

But this may not be the case of all. The small firm may, because of its experience in a specialized field, outperform the large one in both quality and speed. It is some years if they are able to produce the desired product at a cost point with only minor modifications of an earlier development for some other contractor.

If the avionics industry is to make maximum studies in its research and development effort, it must put less emphasis on engineering everything possible under its own roof and make better use of the nation's total engineering capability, spread among thousands of companies of every size.



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9. Torque generator linearity.
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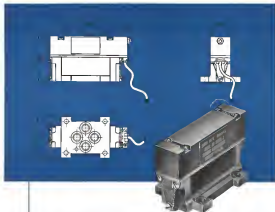
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TO: Dynamotor Users  
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The Wincharger Corporation's long history of producing dynamotors equal to or better than the Armyability Quality Level established by the government has resulted in the Signal Corps' selection of Winco dynamotors for its Reduced Inspection Quality Assurance Plan.

As of this writing, Wincharger is the only manufacturer of dynamotors qualified under RIQAP. Only those suppliers who have consistently furnished material of the highest quality level and who maintain quality control and inspection methods and procedures acceptable to the Signal Corps are considered for this honor.

The new Signal Corps plan places more responsibility for maintenance of quality on the manufacturer by reducing the amount of government inspection. It is an honor inspection program.

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## WINCHARGER CORPORATION

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GENERATOR MODEL	TRANSDUCER CLEANING AREA
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APT-500	1 sq ft
APT-4000	4 sq ft

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BOURNS now offers an  
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... 7 stock models of  
sub-miniature potentiometers  
to serve many special needs—  
at no extra cost!

First there's the 120 Wirewound TRIMPOT, with features common to all other BOURNS TRIMPOTS. It's a 25 turn potentiometer, easily adjusted, and weighing only 0.1 oz. Rectangular in shape, it fits readily into miniature electronic circuits. You can mount it individually, in stack it remotely with standard screws. Mountings are interchangeable with those on all other TRIMPOTS.

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Now, to give designers greater latitude, BOURNS has developed and is manufacturing the following standard models—variations of the Model 120

<p><b>120 TRIMPOT</b> —Carbon Wirewound For where absolute linearity is required by the system designer. Resistance and tolerance ranging from 10,000 ohms to 20,000 ohms at 0.2%.</p>	<p><b>130 TRIMPOT</b> —Taper Leg For where absolute linearity is not required, using centering the legs in the centering mechanism. Resistance range as 10,000 ohms to 20,000 ohms at 0.2%.</p>	<p><b>132 TRIMPOT</b> —Resistor Element For where absolute linearity is not required, using centering the legs in the centering mechanism. Resistance range as 10,000 ohms to 20,000 ohms at 0.2%.</p>
<p><b>200 TRIMPOT</b> —Dual Potentiometer Two potentiometers electrically independent, and controlled almost precisely by the adjustment.</p>	<p><b>140 TRIMPOT</b> —High Temperature Operates at 175-175 high temp. rating. 0.5 watt at 100°C.</p>	<p><b>130 TRIMPOT</b> —Heavy Duty Compensating system, with centering the legs. See BOURNS for details.</p>



Write for literature on the BOURNS TRIMPOT line

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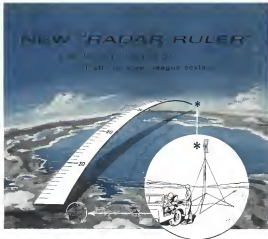
RCA is a major supplier of airborne fire control equipment to the Armed Forces.

It has produced, and in several instances developed, these systems for many of the latest aircraft. Some of these are illustrated above.



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2	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"
3	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"

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1	0.001"	1	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"
2	0.01"	2	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"
3	0.1"	3	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"

400-CYCLE SERVO MOTOR		MODEL	INPUT RANGE	INPUT IMPEDANCE	OUTPUT RANGE	OUTPUT IMPEDANCE	LINEARITY	REPEATABILITY	STABILITY	TEMPERATURE RANGE	WEIGHT	PRICE	WARRANTY
1	0.001"	1	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"
2	0.01"	2	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"
3	0.1"	3	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"

400-CYCLE SERVO MOTOR		MODEL	INPUT RANGE	INPUT IMPEDANCE	OUTPUT RANGE	OUTPUT IMPEDANCE	LINEARITY	REPEATABILITY	STABILITY	TEMPERATURE RANGE	WEIGHT	PRICE	WARRANTY
1	0.001"	1	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"
2	0.01"	2	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"
3	0.1"	3	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"

400-CYCLE SERVO MOTOR		MODEL	INPUT RANGE	INPUT IMPEDANCE	OUTPUT RANGE	OUTPUT IMPEDANCE	LINEARITY	REPEATABILITY	STABILITY	TEMPERATURE RANGE	WEIGHT	PRICE	WARRANTY
1	0.001"	1	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"
2	0.01"	2	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"
3	0.1"	3	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"

400-CYCLE SERVO MOTOR		MODEL	INPUT RANGE	INPUT IMPEDANCE	OUTPUT RANGE	OUTPUT IMPEDANCE	LINEARITY	REPEATABILITY	STABILITY	TEMPERATURE RANGE	WEIGHT	PRICE	WARRANTY
1	0.001"	1	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"
2	0.01"	2	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"
3	0.1"	3	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"

400-CYCLE SERVO MOTOR		MODEL	INPUT RANGE	INPUT IMPEDANCE	OUTPUT RANGE	OUTPUT IMPEDANCE	LINEARITY	REPEATABILITY	STABILITY	TEMPERATURE RANGE	WEIGHT	PRICE	WARRANTY
1	0.001"	1	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"	0.001"
2	0.01"	2	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"	0.01"
3	0.1"	3	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"

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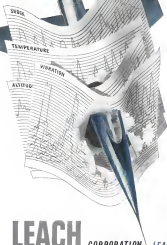


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Available for 15, 30 or 1 inch tape. Same tape speeds, heads and other characteristics as Ampex reel to reel models.

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**FR-1100**—As successor to Ampex's long established 500 series recorders, the FR-1100 is comparable in cost and provides similarly reliable performance. Its improvements are low tape speeds, interchangeable plug-in amplifiers, interchangeable heads, pushbutton controls and better performance specifications.

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A mark of the Ampex leadership in magnetic tape recorders is the fact that every machine produced equals or exceeds all published performance specifications. A general tape instrumentation brochure and descriptive literature on various models are available on request. Write Dept. U2 2198

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INSTRUMENTATION DIVISION

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Circle Number 40 on Reader Service Card

C-12

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Reels	Tracks	1/2	1/4	1/8	1/16	1/32	1/64	1/128	1/256	1/512	1/1024	1/2048	1/4096
1000	500	250	125	62.5	31.25	15.625	7.8125	3.90625	1.953125	0.9765625	0.48828125	0.244140625	0.1220703125
700	350	175	87.5	43.75	21.875	10.9375	5.46875	2.734375	1.3671875	0.68359375	0.341796875	0.1708984375	0.08544921875
450	225	112.5	56.25	28.125	14.0625	7.03125	3.515625	1.7578125	0.87890625	0.439453125	0.2197265625	0.10986328125	0.054931640625
1800	900	450	225	112.5	56.25	28.125	14.0625	7.03125	3.515625	1.7578125	0.87890625	0.439453125	0.2197265625
1350	675	337.5	168.75	84.375	42.1875	21.09375	10.546875	5.2734375	2.63671875	1.318359375	0.6591796875	0.32958984375	0.164794921875
1400	700	350	175	87.5	43.75	21.875	10.9375	5.46875	2.734375	1.3671875	0.68359375	0.341796875	0.1708984375
31400	15700	7850	3925	1962.5	981.25	490.625	245.3125	122.65625	61.328125	30.6640625	15.33203125	7.666015625	3.8330078125
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## SUPPORTING EQUIPMENT



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## SECTION

1957 AVIATION WEEK BUYERS GUIDE

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Quenching force  
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Environmentally  
weather-resistant  
Special model 54-3  
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+40° to +210°  
F. operation.  
Write for  
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## TYPE 5 SWITCHES



EPA-823



doi:10.1371/journal.pone.0141123.g002

HERMETICALLY-SEALED  
DOUBLE-BOLT SWITCH

Journal of Management Education 32(1)



DPST, 4 (width 30  
350 x 45/30 x 30).

### Support Items Vital to Development

By George L. Christian

The wear-and-tear and reliability of aircraft equipment and systems—hydraulic and pneumatic, electrical and cartridge-actuated—must be of the same high order of integrity as the basic airframe or engine is today's supersonic fighters and multi-million-dollar bombers.

Failure of this component, or one of several portions of the system that powers, can be catastrophic. The rupture of a simple hydraulic fitting can have the same disastrous results as the crumbling of a wing's main spar or the disintegration of the powerplant.

As an engineer for one of the country's largest equipment manufacturers put it, "a statistical approach to the design of equipment is no longer tolerable when dealing in human life and in weapons systems which are as complex and costly as those flying today and those which will fly tomorrow."

For instance, nearly seven several hundreds of thousands of dollars, capable of throwing out the most efficient and most advanced of the modern transport systems in most cities beyond money lines with modern vehicles, will be totally ineffectual without out all the paraphernalia attendant to the operation of the system. The set up of a vast array of men and machines (needed to a man's intense aversion to transport the vehicle, the fuel which is often badly designed, the changing gears, the noise, the heat, the pollution, the congestion, the parking, the loading and unloading, the

Not an weapon training problem solved to guided missiles. The very

### Circle of Support

Once established at the branching site, all the support component must function efficiently to allow the service

How are examples of how simple system failures can destroy a multi-million dollar aircraft.

- Hydraulic systems before can position a piston. Hydrostatics powered, high pressure, hydraulic systems are not possible to the pilot to fit his task.
- Pneumatic failure on such planes as the B-52, B-47 or B-46, where all the systems are powered by compressed air, hydraulic and electrical, unpowered can be as disastrous as failure of the primary structure.
- Directional control quality short field take.
- Carriage actuated devices, if they fail to erect a pilot or perform other essential, can cause destruction of pilot.

The problems which "support equipment" must solve are highlighted in this diagram. How do you turn a man to launch a missile as lethal, complex, and costly as one the DCRMP Re-

of equipment failure. Among the latter are the pop-out type of airbrake hydraulic pump and/or generator which the pilot can drop into the slip stream to supply the vital hydraulic or electrical power which is necessary to enable him to fly the plane and make a safe landing.

The David & Goliath relationship between secondary and weapon systems is vividly illustrated by the first test 8-32 took last Feb. 23. The giant jet was knocked out of the sky by a two-inch wheel disintegrating parts of which blasted through one of the plane's fuel tanks. (The release was powered by the 8-32's low-pressure pneumatic system and drove one of the electrical system's main solenoids).

The high degree of reliability required of military equipment used on today's fighting planes and tomorrow's commercial jets has imposed additional demands on equipment manufacturers in the form of protective devices for engine power plants.

In hydraulic systems, for instance, pump efficiencies had to be improved to make the units small and light enough to squeeze into modern jet fighters.

<sup>3</sup>The led to pump ports being made to extremely close tolerances—we are happy to tolerance of one-half millionth of an inch.

As a result, the hydraulic fluid had to be kept free of dirt, chips and other foreign matter. To stave the flood of oil contaminants down to 10 microns, new filters had to be devised which would do the job, yet not impose undue pressure drops on the system. This was accomplished by a variety of means in both worn metal filters.

### Weapon Systems

With the implementation of the weapon systems at the Air Force, now a whole family of support items for the weapon systems, not as closely related as auxiliary equipment and systems, but equally important to the weapon completing its mission, are set fully.

The entire weapon system concept, including sometimes dozens of support items, has assumed such a degree of importance that the airframe itself—whether airplane or missile—slides into a position of secondary importance compared to the overall weapon system.

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*and*  
**DUCTING COMPONENTS**  
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 <p><b>STAINLESS STEEL BELLOWS</b> Made in sizes ranging from 1" to 18". Arrowhead stainless steel bellows are available with single and multiple walls for handling compressed (dead) air at temperatures up to 900°F and pressures to 250 psi.</p>	 <p><b>PRESSURE COMPENSATORS</b> There are three kinds of Arrowhead pressure compensating chambers—Internal Pressure Type, Internal Pressure Type and External Pressure Type. Each is designed to solve specific problems of fluid thrust.</p>	 <p><b>INTERNAL TIE-RODS</b> DOUBLE END TYPE This bellows tie-rod assembly shows anchor rings at great points on the bellows center line to anchor the ends of the bellows. Fabricated in all diameters from 1" to 8".</p>
 <p><b>DUCTING COMPONENTS</b> Arrowhead manufactures all types and shapes of ducting components for countless applications requiring the handling of compressed air at temperatures up to 900°F and pressures to 250 psi.</p>	 <p><b>BRAZED BELLOWS</b> Special construction of Arrowhead bellows brazed assemblies eliminates wear on fire and gas solutions. Available in standard sizes from 1" to 18".</p>	 <p><b>INTERNAL TIE-RODS</b> SINGLE END TYPE This bellows tie-rod assembly anchors the ends of the bellows at a single point along the bellows center line. Manufactured in all diameters from 1" to 8".</p>

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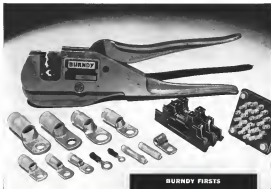
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Fits standard SAE/ANSI  
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positive locking provided by two non-  
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one-piece, all-machined lock and nut body.  
Positive locking is accomplished by the  
slotted locking system which locks on the  
threads of the bolt. Designed for inspection  
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#### SPS PRESSURE PLUGS

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AN-365 1/2-20 through 1 1/2-12  
Fits standard Specification AN-N-5 and  
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AN-801 and AN-365 nuts are made of  
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#### SPECIFICATIONS

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Accuracy:  $\pm 3.15\%$  full scale  
Pressure display: 0 to 100 lb. (0-100 lb.)  
Diameter: 1.5 in. (approx.)  
Weight: 1.5 lb. (approx.)  
For use on aircraft equipment and  
components: will effect testing in situ  
size 1.5 lb.

#### Transmitter, Model 210-100



Power consumption: 0.5  
watt max.  
Weight: 2.0 lb.  
Diameter: 2 1/2 in.  
Length: 4 1/2 in. (approx.)  
Pressure range: 0 to 75 lb.  
0 to 100 psi  
Environmental:  
Min. temperature:  
-45°C  
Low temperature:  
-15°C  
Voltage: 24VDC  
Weight: 2.0 lb.  
For use on aircraft  
equipment and  
components: will  
effect testing in situ  
size 1.5 lb.

#### Indicator, Model 217-100

Power consumption: 0.5  
watt max.  
Weight: 2.0 lb.  
Diameter: 2 1/2 in.  
Length: 4 1/2 in. (approx.)  
Pressure range: 0 to 75 lb.  
0 to 100 psi

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### ENGINE GAGES



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LOCKHEED F-104 STARFIGHTER

## AVIATION WEEK



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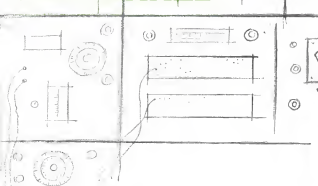
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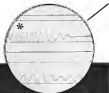
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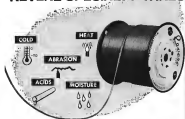


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CREATIVE RESEARCH AND DEVELOPMENT — PRECISION ENGINEERING AND PRODUCTION

# Important Points To Be Remembered



## AN-Type Steel or Aluminum Shipper Plugs and Caps

Designed to conform to all applicable specifications. Gaskets for plugs are ordered separately. These closures will seal hand tight on fittings of 37° nose taper.



## AN-Type Cadmium Plated Steel Caps and Plugs

Caps are designed for units with external threads and plugs are for internal threaded service connections. Both conform to all applicable specifications and will seal hand tight on fittings of 37° nose taper.



## AAF-Type Cadmium Plated Steel Seal Caps and Plugs

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# Airline Buying Follows Set Patterns

New York—Purchasing procedures of both U.S. and foreign airlines have not changed appreciably during the past year, even under the impact of international-dollar purchasing commitments for turbojet and turboprop aircraft. However, in delivery of the completely new-type airplane draws new, certain, unexpected changes will undoubtedly take place.

Some airlines, such as Pan American World Airways, are establishing new procedures for jet procurement, but they are relatively minor and fit neatly into the framework of the aircraft buying purchasing organizations.

Often any jet purchases will be no different at all on these procurement policies.

## Two Different Patterns

Airlines have set two basically different types of purchasing procedures.

A central purchasing decision which takes care of all procurement requirements for the airline, except possibly,

for very small amounts of local purchases which is undertaken for local airlines. For local, such an organization is in the Service of Supply of Long Island City, N. Y.

The same practice is usually followed by smaller airlines which coordinate extensive activities, technical and maintenance base, and purchasing all in one location.

Trans World Airlines, the other U.S. transoceanic airline, has a purchasing organization quite similar to TWA's, except that TWA also established an international purchasing office in Paris to buy some of the supplies which originate in Europe.

The second scheme is to have two major purchasing centers, each for certain, specific categories of items. Two large carriers which are proponents of this type of purchasing organization are American Airlines and United Air Lines.

Both AA and UAL split their procurement between their own offices and their central bases—for American,

New York and Tulsa, for United, Chicago and San Francisco.

Since all foreign airlines operating into the U.S. by American-built aircraft must comply with American export, gun policies, and about 100% American equipment and accessories, these carriers have established purchasing offices in the U.S.

Foreign Airlines

Since all foreign airlines operating into the U.S. by American-built aircraft must comply with American export, gun policies, and about 100% American equipment and accessories, these carriers have established purchasing offices in the U.S.

Though most of the transoceanic foreign airlines have placed orders for the Boeing 707 or Douglas DC-8 freight transporters, the aircraft of these carriers has not yet been fully by their procurement departments because delivery is still too late in the future.

## CONSOLIDATED LISTING OF CAA APPROVED REPAIR STATIONS

(AS OF JULY 1, 1956)

This listing is divided into CAA regions, each region being further divided alphabetically by state. Requests for information relative to CAA approved repair stations should be directed to the Regional Administrator, CAA, at the address shown at the head of the regional listing.

Foreign repair stations are noted in the same general manner as domestic stations; however, all ratings, and/or domestic ratings, are subject to specific limitations imposed by the Administrator. For further information regarding such limitations, it is suggested that communications be directed to the Washington office of the Civil Aeronautics Administration, attention IB-1.

A limited rating indicates that the repair station specializes or chooses to be rated for some particular product or specialized technique. The privileges of such stations are the same as a class type station but only in respect to the product or service for which it is rated. Class type stations usually cover a broader field of activity than a station with a limited rating.

The detailed limitations of all certificated repair stations are stated on the Operations Specifications, Form ACA-350-1, pages 1 and 2, which is required to be prominently displayed on the premises of the station.

For further information regarding repair station privileges and privileges, refer to Civil Aeronautics Manual 22, Repair Station Certificates, which is on sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, 25, D.C., for \$1.60 per copy.

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